4.3 Remote Port User Interface

The Remote Port of the DM240 allows for complete control and monitor functions via an RS-485 Serial Interface.

Control and status messages are conveyed between the DM240 and the subsidiary modems, and the host computer using packetized message blocks in accordance with a proprietary communications specification. This communication is handled by the Radyne Link Level Protocol (RLLP), which serves as a protocol ‘wrapper’ for the M&C data.

Complete information on monitor and control software is contained in the following sections.

4.3.1 Protocol Structure

The Communications Specification (COMMSPEC) defines the interaction of computer resident Monitor and Control software used in satellite earth station equipment such as modems, redundancy switches, multiplexers, and other ancillary support gear. Communication is bi-directional, and is normally established on one or more full-duplex multi-drop control buses that conform to EIA Standard RS-485.

Each piece of earth station equipment on a control bus has a unique physical address, which is assigned during station setup/configuration or prior to shipment. Valid decimal addresses on one control bus range from 032 through 255 for a total of up to 224 devices per bus. Address 255 of each control bus is usually reserved for the M&C computer.

4.3.2 Protocol Wrapper

The Radyne COMMSPEC is byte-oriented, with the Least Significant Bit (LSB) issued first. Each data byte is conveyed as mark/space information with two marks comprising the stop data. When the last byte of data is transmitted, a hold comprises one steady mark (the last stop bit). To begin or resume data transfer, a space substitutes this mark. This handling scheme is controlled by the hardware and is transparent to the user. A pictorial representation of the data and its surrounding overhead may be shown as follows:

S1	S2	B_0	B_1	B_2	B_3	B_4	B_5	B_6	B_7	S1	S2, etc.

The stop bits, S1 and S2, are each a mark. Data flow remains in a hold mode until S2 is replaced by a space. If S2 is followed by a space, it is considered a start bit for the data byte and not part of the actual data (B_0 - B_7).

The COMMSPEC developed for use with the Radyne Link Level Protocol (RLLP) organizes the actual monitor and control data within a shell, or "protocol wrapper", that surrounds the data. The format and structure of the COMMSPEC message exchanges are described herein. Decimal numbers have no suffix; hexadecimal numbers end with a lower case h suffix and binary values have a lower case b suffix. Thus, 22 = 16h = 000010110b. The principal elements of a data frame, in order of occurrence, are summarized as follows:

<SYNC> - the message format header character, or ASCII sync character, that defines the beginning of a message. The <SYNC> character value is always 16h.

<BYTE COUNT> - the Byte Count is the number of bytes in the <DATA> field, ranging from 0 through TBD. This field is 2 bytes long for the DM240 protocol.

<SOURCE ID> - the Source Identifier defines the message originator’s multidrop address. Note that all nodes on a given control bus have a unique address that must be defined.

<DESTINATION ID> - The Destination Identifier specifies the multidrop address of the device(s) to which the message is sent.

<FRAME SEQUENCE NUMBER> - The FSN is a tag with a value from 0 through 255 that is sent with each message. It assures sequential information framing and correct equipment acknowledgment and data transfers.

<OPCODE> - The Operation Code field contains a number that identifies the message type associated with the data that follows it. Acknowledgment and error codes are returned in this field. This field is 2 Bytes for the DM240 protocol.

<...DATA...> - The Data field contains the binary, data bytes associated with the <OPCODE>. The number of data bytes in this field is indicated by the <BYTE COUNT> value.

<CHECKSUM> - The checksum is the modulo 256 sum of all preceding message bytes, excluding the <SYNC> character. The checksum determines the presence or absence of errors within the message. In a message block with the following parameters, the checksum is computed as shown below in Table 4-4.

Table 4-4. Checksum Calculation Example

BYTE FIELD	DATA CONTENT	RUNNING CHECKSUM
<BYTE COUNT> (Byte 1)	00h = 00000000b	00000000b
<BYTE COUNT> (Byte 2)	02h = 00000010b	00000010b
<SOURCEID>	F0h = 11110000b	11110010b
<DESTINATION ID>	2Ah = 00101010b	00011100b
<FSN>	09h = 00001001b	00100101b
<OPCODE> (Byte 1)	00h = 00000000b	00101000b
<OPCODE> (Byte 2)	03h = 00000011b	00101000b
<DATA> (Byte 1)	DFh = 11011111b	00000111b
<DATA> (Byte 2)	FEh = 11111110b	00000101b

Thus, the checksum is 00000101b; which is 05h or 5 decimal. Alternative methods of calculating the checksum for the same message frame are:

00h + 02h + F0h + 2Ah + 09h + 00h + 03h + DFh + FEh = 305h.

Since the only concern is the modulo 256 (modulo 100h) equivalent (values that can be represented by a single 8-bit byte), the checksum is 05h.

For a decimal checksum calculation, the equivalent values for each information field are:

0 + 2 + 240 + 42 + 9 + 0 + 3 + 223 + 254 = 773;

773/256 = 3 with a remainder of 5. This remainder is the checksum for the frame.

5 (decimal) = 05h = 0101b = <CHECKSUM>

4.3.3 Frame Description and Bus Handshaking

In a Monitor and Control environment, every message frame on a control bus port executes as a packet in a loop beginning with a wait-for-SYN-character mode. The remaining message format header information is then loaded, either by the M&C computer or by a subordinate piece of equipment requesting access to the bus. Data is processed in accordance with the OPCODE, and the checksum for the frame is calculated. If the anticipated checksum does not match then the wait-for-SYN mode goes back into effect. If the OPCODE resides within a command message, it defines the class of action that denotes an instruction that is specific to the device type, and is a prefix to the DATA field if data is required. If the OPCODE resides within a query message packet, then it defines the query code, and can serve as a prefix to query code DATA.

The Frame Sequence Number (FSN) is included in every message packet, and increments sequentially. When the M & C computer or bus-linked equipment initiates a message, it assigns the FSN as a tag for error control and handshaking. A different FSN is produced for each new message from the FSN originator to a specific device on the control bus. If a command packet is sent and not received at its intended destination, then an appropriate response message is not received by the packet originator. The original command packet is then re-transmitted with the same FSN. If the repeated message is received correctly at this point, it is considered a new message and is executed and acknowledged as such.

If the command packet is received at its intended destination but the response message (acknowledgment) is lost, then the message originator (usually the M&C computer) re-transmits the original command packet with the same FSN. The destination device detects the same FSN and recognizes that the message is a duplicate, so the associated commands within the packet are not executed a second time. However, the response packet is again sent back to the source as an acknowledgment in order to preclude undesired multiple executions of the same command.

To reiterate, valid equipment responses to a message require the FSN tag in the command packet. This serves as part of the handshake/acknowledge routine. If a valid response message is absent, then the command is re-transmitted with the same FSN. For a repeat of the same command involving iterative processes (such as increasing or decreasing transmit power level), the FSN is incremented after each message packet. When the FSN value reaches 255, it overflows and begins again at zero.

The full handshake/acknowledgment involves a reversal of source and destination ID codes in the next message frame, followed by a response code in the <OPCODE> field of the message packet from the equipment under control.

4.3.4 Global Response Operational Codes

In acknowledgment (response) packets, the operational code <OPCODE> field of the message packet is set to 0 by the receiving devices when the message intended for the device is evaluated as valid. The device that receives the valid message then exchanges the <SOURCE ID> with the <DESTINATION ID> sets the <OPCODE> to zero in order to indicate that a good message was received, and returns the packet to the originator. This "GOOD MESSAGE" Opcode is one of nine global responses. Global response Opcodes are common responses, issued to the M&C computer or to another device, that can originate from and are interpreted by all Radyne equipment in the same manner. These are summarized as follows (all Opcode values are expressed in decimal form):

RESPONSE OPCODE DESCRIPTION	OPCODE
Good Message	00h
Bad Parameter	FFh
Bad Opcode	FEh

4.3.5 Collision Avoidance

When properly implemented, the physical and logical devices and ID addressing scheme of the COMMSPEC normally precludes message packet contention on the control bus. The importance of designating unique IDs for each device during station configuration cannot be overemphasized. One pitfall, which is often overlooked, concerns multi-drop override IDs. All too often, multiple devices of the same type are assigned in a direct-linked ("single-thread") configuration accessible to the M&C computer directly. For example, if two DM240 Modulators with different addresses (DESTINATION IDs) are linked to the same control bus at the same hierarchical level, both will attempt to respond to the M&C computer when the computer generates a multi-drop override ID of 23. If their actual setup parameters, status, or internal timing differs, they will both attempt to respond to the override simultaneously with different information, or asynchronously in their respective message packets and response packets, causing a collision on the serial control bus.

To preclude control bus data contention, different IDs must always be assigned to the equipment. If two or more devices are configured for direct-linked operation, then the M&C computer and all other devices configured in the same manner must be programmed to inhibit broadcast of the corresponding multi-drop override ID.

The multi-drop override ID is always accepted by devices of the same type on a common control bus, independent of the actual DESTINATION ID. These override IDs with the exception of “BROADCAST” are responded to by all directly linked devices of the same type causing contention on the bus. The “BROADCAST” ID, on the other hand, is accepted by all equipment but none of them returns a response packet to the remote M&C.

The following multi-drop override IDs are device-type specific, with the exception of "BROADCAST". These are summarized below with ID values expressed in decimal notation:

Directly-Addressed Equipment	Multi-Drop Override ID
Broadcast (all directly-linked devices)	00
DMD-3000/4000, 4500 or 5000 Mod Section, DMD15	01
DMD-3000/4000, 4500 or 5000 Demod Section, DMD15	02
RCU-340 1:1 Switch	03
RCS-780 1:N Switch	04
RMUX-340 Cross-Connect Multiplexer	05
CDS-780 Clock Distribution System	06
SOM-340 Second Order Multiplexer	07
DMD-4500/5000 Modulator Section	08
DMD-4500/5000 Demodulator Section	09
RCU-5000 M: N Switch	10
DMD15 Modulator	20
DMD15 Demodulator	21
DMD15 Modem	22
DVB3030 Video Modulator, DM240	23
Reserved for future equipment types	24-31

Note that multi-drop override ID 01 can be used interchangeably to broadcast a message to a DMD-3000/4000 modem, a DMD-4500/5000, a DMD15 modem, or a DVB3030. Radyne Corp. recommends that the multi-drop override IDs be issued only during system configuration as a bus test tool by experienced programmers, and that they not be included in run-time software. It is also advantageous to consider the use of multiple bus systems where warranted by a moderate to large equipment complement.

Therefore, if a DMD15 Modulator is queried for its equipment type identifier, it will return a "20" and DMD15 Demodulator will return a "21". A DMD15 Modem will also return an "22". A DVB3030 Video Modulator will return a “23.”

4.3.6 Software Compatibility

The COMMSPEC, operating in conjunction within the RLLP shell, provides for full forward and backward software compatibility independent of the software version in use. New features are appended to the end of the DATA field without OPCODE changes. Older software simply discards the data as extraneous information without functional impairment for backward compatibility.

If new device-resident or M&C software receives a message related to an old software version, new information and processes are not damaged or affected by the omission of data.

The implementation of forward and backward software compatibility often, but not always, requires the addition of new Opcodes. Each new function requires a new Opcode assignment if forward and backward compatibility cannot be attained by other means.

When Radyne equipment is queried for bulk information (Query Mod, Query Demod, etc.) it responds by sending back two blocks of data; a Non-Volatile Section (parameters that can be modified by the user) and a Volatile Section (status information). It also returns a count value that indicates how large the Non-Volatile Section is. This count is used by M&C developers to index into the start of the Volatile Section.

When new features are added to Radyne equipment, the control parameters are appended to the end of the Non-Volatile Section, and status of the features, if any, are added at the end of the Volatile Section. If a remote M&C queries two pieces of Radyne equipment with different revision software, they may respond with two different sized packets. The remote M&C MUST make use of the non-volatile count value to index to the start of the Volatile Section. If the remote M&C is not aware of the newly added features to the Radyne product, it should disregard the parameters at the end of the Non-Volatile Section and index to the start of the Volatile Section.

If packets are handled in this fashion, there will also be backward-compatibility between Radyne equipment and M&C systems. Remote M&C systems need not be modified every time a feature is added unless the user needs access to that feature.

4.3.7 RLLP Summary

The RLLP is a simple send-and-wait protocol that automatically re-transmits a packet when an error is detected, or when an acknowledgment (response) packet is absent.

During transmission, the protocol wrapper surrounds the actual data to form information packets. Each transmitted packet is subject to time out and frame sequence control parameters, after which the packet sender waits for the receiver to convey its response. Once a receiver verifies that a packet sent to it is in the correct sequence relative to the previously received packet, it computes a local checksum on all information within the packet excluding the <SYN> character and the <CHECKSUM> fields. If this checksum matches the packet <CHECKSUM>, the receiver processes the packet and responds to the packet sender with a valid response (acknowledgment) packet.

The response packet is therefore either an acknowledgment that the message was received correctly. If the sender receives a valid acknowledgment (response) packet from the receiver, the <FSN> increments and the next packet is transmitted as required by the sender.

If an acknowledgment (response) packet is lost, corrupted, or not issued due to an error and is thereby not returned to the sender, the sender re-transmits the original information packet; but with the same <FSN>. When the intended receiver detects a duplicate packet, the packet is acknowledged with a response packet and internally discarded to preclude undesired repetitive executions. If the M&C computer sends a command packet and the corresponding response packet is lost due to a system or internal error, the computer times out and re-transmits the same command packet with the same <FSN> to the same receiver and waits once again for an acknowledgment.

4.3.8 DM240 Opcode Command Set

The DM240 Opcode Command Set is listed below.

4.3.9 Modulator Command Set

Command	Opcode
Query Mod All	2400h
Query Mod Latched Alarms	2405h
Query Mod Current Alarms	2408h
Query Mod Status	240Bh
Query Time	240Eh
Query Date	240Fh
Query Time and Date	2410h
Query Firmware Part/Rev	2414h
Query AASI NULL PID (w/IPSat interface card only)	2456h
Query IPSat Burst Demod Count (w/IPSat interface card only)	2457h
Query IPSat Control PID (w/IPSat interface card only)	2458h
Query IPSat Enable (w/IPSat interface card only)	2459h
Query IPSat User Data Rate (w/IPSat interface card only)	245Ah
Query PCR Restamping	245Bh
Query Multi-PIIC Configuration (w/Multi-PIIC interface card only)	245Ch
Query Multi-PIIC Status (w/Multi-PIIC interface card only)	245Dh
Query RF Switch Status (w/RF Switch hardware only)	2560h
Command Mod Configuration	2601h
Command Mod Single Parameter:	
Frequency	2602h
Data Rate	2604h
Modulation Type	2606h

Inner FEC Rate	2607h
Tx On/Off	2609h
Carrier Test	260Ah
Input Clock Control	260Bh
Input Clock Polarity	260Ch
Transmit Power Level	260Fh
Spectrum	2611h
Reference Source	2616h
Network Specification	2619h
External Reference Frequency	261Bh
Data Polarity	2620h
Terrestrial Interface Type	2621h
Terrestrial Frame Size	2640h
Carrier Set Roll Off	2641h
Output Clock Control	2642h
Symbol Rate	2643h
AASI NULL PID (w/IPSat interface card only)	2656h
IPSat Burst Demod Count (w/IPSat interface card only)	2657h
IPSat Control PID (w/IPSat interface card only)	2658h
IPSat Enable (w/IPSat interface card only)	2659h
Command PCR Restamping	265Bh
Command Multi-PIIC Configuration (w/Multi-PIIC interface card only)	265Ch
Command Clear Latched Alarms	2C03h
Command Set Time	2C04h
Command Set Date	2C05h
Command Set Time and Date	2C06h
Command RF Switch Redundancy Mode (w/RF Switch hardware only)	2F40h
Command RF Switch Fault Test (w/RF Switch hardware only)	2F41h
Command RF Switch Active Side (w/RF Switch hardware only)	2F42h

4.3.10 Detailed Command Descriptions

Opcode: <2400h> (Query Mod All) Query a Modulator's Configuration and Status

Query Response		
<1>	Number of Nonvol bytes	Number of Configuration Bytes
Configuration Bytes		

<4>	IF Frequency	Binary Value, units Hz in 100 Hz steps. 50000000 Hz to 180000000 Hz 70/140 950000000 Hz to 2050000000 Hz L-Band
<2>	Reserved	TBD
<4>	Data Rate	Binary Value, 1 bps steps
<4>	External Reference	Binary Value, units Hz in 8000 Hz steps, e.g. 1000000 Hz, 1008000 Hz, etc., range = 256000 Hz to 10000000 Hz
<1>	Frequency Reference Source	0 = Internal, 1 = External
<1>	Modulation Type	0 = QPSK, 1 = BPSK, 2 = 8PSK, 3 = 16QAM
<1>	Inner FEC Rate	1 = 1/2 Rate, 2 = 2/3 Rate, 3 = 3/4 Rate, 4 = 5/6 Rate, 5 = 7/8 Rate, 6 = 6/7 Rate, 7 = 4/5 Rate, 8 = 8/9 Rate, 9 = 9/10 Rate, 128 = 1/4 Rate, 129 = 1/3 Rate, 130 = 2/5 Rate, 131 = 3/5 Rate
<1>	Reserved	TBD, Default = 1
<1>	Reserved	TBD, Default = 1
<1>	Reserved	TBD, Default = 0
<1>	Reserved	TBD, Default = 0
<2>	Transmit Power Level	Signed Value. +0 to –250 (+0.0 to –25.0 dBm) (two's compliment)
<1>	Carrier Control	0 = Off, 1 = On
<1>	Carrier Test	0 = Off, 1 = CW, 2 = Dual, 3 = Offset, 4 = Pos FIR, 5 = Neg FIR
<1>	Spectrum	0 = Inverted, 1 = Normal
<1>	Reserved	TBD, 0 = Default
<1>	Tx Interface Type	0 = Serial, 1 = Parallel, 2 = ASI_Norm, 3 = ASI_Null, 4 = G.703E3, 5 = G.703 T3, 6 = G.703 STS-1, 7 = HSSI, 8 = Parallel DVB, 9 = Parallel M2P, 10 = None, 11 = DirecTV, 13 = OC3, 14 = STM-1, 15 = G.703 E2, 16 = G.703 T2 Bal, 17 = G.703 T2 UNBAL, 18 = G.703 E1 Bal, 19 = G.703 E1 UNBAL, 20 = G.703 T1 AMI 21 = G.703 T1 B8ZS
<1>	Input Clock Polarity	0 = Normal, 1 = Inverted
<1>	Data Polarity	0 = Normal, 1 = Inverted
<1>	Input Clock Source	0 = SCTE, 1 = SCT

<1>	Reserved	TBD, Default = 0
<11>	Reserved	TBD
<1>	Reserved	TBD
<1>	Major Alarm Mask	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock Bit 7 = Spare 0 = Mask, 1 = Allow
<1>	Minor Alarm Mask	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Mask, 1 = Allow
<1>	Common Fault Mask	Bit 0 = -12 V Alarm Bit 1 = +12 V Alarm Bit 2 = +5 V Alarm Bits 3 – 7 = Spares 0 = Mask, 1 = Allow
<1>	Reserved	TBD, Default = 0
<4>	Symbol Rate	Symbol Rate in Symbols Per Second
<1>	Terrestrial Framing	0 = 188 Byte, 1 = 204 Byte, 2 = No Framing, 3 = DirecPC, 4 = DirecTV
<1>	Roll Off	0 = 0.35, 25 = 0.25, 1 = 0.20
<1>	Reserved	TBD
<1>	Output Clock Source	0 = SCTE, 1 = SCT, 2 = None
<1>	Network Spec	0 = DVB-S, 1 = Direct PC, 9 = DirecTV, 11 DVB-S2 BS NBC, 12 = DVB-S2 BS BC, 13 = DirecTV AMC NBC, 14 = DirecTV AMC BC
<1>	Scrambler Bypass	0 = Normal, 1 = Bypass
<1>	Outer FEC Bypass	0 = Normal, 1 = Bypass
<1>	Test Pattern	0 = None, 1 = 215 – 1, 23 = 223-1

<1>	Last Rate Control	0 = Symbol Rate, 1 = Data Rate, 2 = Auto
<1>	Interleaver Bypass	0 = Bypass, 1 = Normal
<1>	PCR Restamping	0 = Off, 1= On
<1>	Multi-PIIC Mode	Without Multi-PIIC Card: 1 = Manual With Multi-PIIC Card: 1 = Manual, 2 = Redundancy
<1>	Redundancy Mode	Without Multi-PIIC Card or Manual Multi-PIIC Mode: 0 With Multi-PIIC Card: 0 = Force Prime, 1 = Force Backup, 2 = Manual Revert, 3 = Auto-Revert
<1>	Prime PIIC Slot	Without Multi-PIIC Card: 1 With Multi-PIIC Card: 1 – 3
<1>	Backup PIIC Slot	Without Multi-PIIC Card: 1 With Multi-PIIC Card: 1 – 3
<1>	Pilot Symbols	0 = Off, 1 = On
<1>	Inner FEC Bypass	0 = Normal, 1 = Bypass
<1>	PL Scrambler Bypass	0 = Normal, 1 = Bypass
<1>	PL Noise Generator Enable	0 = Disable, 1 = Enable
<1>	PL Noise Generator Profile	1 to 16
<2>	PL Header Scrambler Seq Index	1 to 2000
<4>	Gold Code Seq Index	0 to 262142

Status Bytes		
<1>	Reserved	TBD
<1>	Reserved	TBD
<1>	Reserved	TBD
<1>	Major Alarm	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock Bit 7 = Spare 0 = Pass, 1 = Fail
<1>	Minor Alarm	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Pass, 1 = Fail
<1>	Common Fault	Bit 0 = -12 V Alarm. 1 = Fail Bit 1 = +12 V Alarm. 1 = Fail Bit 2 = +5 V Alarm. 1 = Fail Bits 3 - 7 = Spares 0 = Pass, 1 = Fail
<1>	Latched Major Alarm	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock Bit 7 = Spare 0 = Pass, 1 = Fail
<1>	Latched Minor Alarm	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Pass, 1 = Fail
<1>	Latched Common Fault	Bit 0 = -12 V Alarm. 1 = Fail Bit 1 = +12 V Alarm. 1 = Fail Bit 2 = +5 V Alarm. 1 = Fail Bits 3 – 7 = Spares

		0 = Pass, 1 = Fail
<1>	Reserved	
<1>	+5 Voltage	Implied Decimal Point. 49 = +4.9 V
<1>	+12 Voltage	Implied Decimal Point. 121 = +12.1 V
<1>	-12 Voltage	-12 V. Implied Decimal Point and Minus Sign. 118 = -11.8 V
<2>	Reserved	TBD
<2>	Reserved	TBD
<1>	Last Rate Status	0 = Symbol Rate, 1 = Data Rate
<1>	Active PIIC Slot	Without Multi-PIIC Card: 1 With Multi-PIIC Card: 1 – 3
<1>	Slot 1 PIIC Type	Without Multi-PIIC Card: 0x01 = RS-422 Serial 0x07 = ASI and RS422 Parallel 0x08 = ASI and LVDS Parallel 0x82 = DirecTV PECL 0x83 = G.703 (E1, T1, E2, T2 E3, T3, STS-1) 0x84 = HSSI 0x89 = IPSAT 0xFF = None With Multi-PIIC Card: 0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	Slot 2 PIIC Type	Without Multi-PIIC Card: Unused With Multi-PIIC Card: 0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	Slot 3 PIIC Type	Without Multi-PIIC Card: Unused With Multi-PIIC Card: 0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None

<1>	PIIC Clock Activity	Without Multi-PIIC Card: Unused With Multi-PIIC Card: Bit 1 = Slot 1 Activity Bit 2 = Slot 2 Activity Bit 3 = Slot 3 Activity
<1>	PIIC Data Activity	Without Multi-PIIC Card: Unused With Multi-PIIC Card: Bit 1 = Slot 1 Activity Bit 2 = Slot 2 Activity Bit 3 = Slot 3 Activity

Opcode: <2403h> Query a Modem's Identification **(TBD)**

Query response		
<1>	Modem ID	DM240 modulator = 23

Opcode: <2405h> Query a Modulator's Latched Alarms

Query response		
<1>	Latched Major Alarm	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock Bit 7 = Spare 0 = Pass, 1 = Fail
<1>	Latched Minor Alarm	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Pass, 1 = Fail
<1>	Latched Common Fault	Bit 0 = -12 V Alarm. 1 = Fail Bit 1 = +12 V Alarm. 1 = Fail Bit 2 = +5 V Alarm. 1 = Fail Bits 3 – 7 = Spares 0 = Pass, 1 = Fail

Opcode: <2408h> Query a Modulator's Current Alarms

Query response		
<1>	Major Alarm	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock

		Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock Bit 7 = Spare 0 = Pass, 1 = Fail
<1>	Minor Alarm	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Pass, 1 = Fail
<1>	Common Fault	Bit 0 = -12 V Alarm. 1 = Fail Bit 1 = +12 V Alarm. 1 = Fail Bit 2 = +5 V Alarm. 1 = Fail Bits 3 - 7 = Spares 0 = Pass, 1 = Fail

Opcode: <240Bh> Query a Modulator's Status

Query Response		
<1>	Reserved	TBD
<1>	Reserved	TBD
<1>	Reserved	TBD
<1>	Major Alarm	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock Bit 7 = Spare 0 = Pass, 1 = Fail
<1>	Minor Alarm	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Pass, 1 = Fail
<1>	Common Fault	Bit 0 = -12 V Alarm. 1 = Fail Bit 1 = +12 V Alarm. 1 = Fail Bit 2 = +5 V Alarm. 1 = Fail

		Bits 3 - 7 = Spares 0 = Pass, 1 = Fail
<1>	Latched Major Alarm	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock Bit 7 = Spare 0 = Pass, 1 = Fail
<1>	Latched Minor Alarm	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Pass, 1 = Fail
<1>	Latched Common Fault	Bit 0 = -12 V Alarm. 1 = Fail Bit 1 = +12 V Alarm. 1 = Fail Bit 2 = +5 V Alarm. 1 = Fail Bits 3 – 7 = Spares 0 = Pass, 1 = Fail
<1>	Reserved	
<1>	+5 Voltage	Implied Decimal Point. 49 = +4.9 V
<1>	+12 Voltage	Implied Decimal Point. 121 = +12.1 V
<1>	-12 Voltage	-12 V. Implied Decimal Point and Minus Sign. 118 = -11.8 V
<2>	Reserved	TBD
<2>	Reserved	TBD
<1>	Last Rate Status	0 = Symbol Rate, 1 = Data Rate
<1>	Active PIIC Slot	Without Multi-PIIC Card: 1 With Multi-PIIC Card: 1 – 3
<1>	Slot 1 PIIC Type	Without Multi-PIIC Card: 0x01 = RS-422 Serial 0x07 = ASI and RS422 Parallel 0x08 = ASI and LVDS Parallel 0x82 = DirecTV PECL 0x83 = G.703 (E1, T1, E2, T2 E3, T3, STS-1) 0x84 = HSSI 0x89 = IPSAT 0xFF = None

		With Multi-PIIC Card: 0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	Slot 2 PIIC Type	Without Multi-PIIC Card: Unused With Multi-PIIC Card: 0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	Slot 3 PIIC Type	Without Multi-PIIC Card: Unused With Multi-PIIC Card: 0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	PIIC Clock Activity	Without Multi-PIIC Card: Unused With Multi-PIIC Card: Bit 1 = Slot 1 Activity Bit 2 = Slot 2 Activity Bit 3 = Slot 3 Activity
<1>	PIIC Data Activity	Without Multi-PIIC Card: Unused With Multi-PIIC Card: Bit 1 = Slot 1 Activity Bit 2 = Slot 2 Activity Bit 3 = Slot 3 Activity

Opcode: <240Eh> Query Time

Query Response		
<1>	Hour	0 – 23
<1>	Minute	0 – 59
<1>	Second	0 – 59

Opcode: <240Fh> Query Date

Query Response

<1>	Year	0 – 99
<1>	Month	1 – 12
<1>	Day	1 – 31

Opcode: <2410h> Query Time and Date

Query Response		
<1>	Year	0 – 99
<1>	Month	1 – 12
<1>	Day	1 – 31
<1>	Hour	0 – 23
<1>	Minute	0 – 59
<1>	Second	0 – 59

Opcode: <2414h> Query Firmware Part/Rev

Query Response		
<16>	Firmware Part/Rev	ASCII null terminated string

Opcode: <2456h> Query AASI NULL PID

Query Response		
<2>	PID	0x0010 - 0x1FFF

Opcode: <2457h> Query IPSat Burst Demod Count

Query Response		
<2>	Num Burst Demods	1 – 50

Opcode: <2458h> Query IPSat Control PID

Query Response		
<2>	PID	0x0010 - 0x1FFF

Opcode: <2459h> Query IPSat Enable

Query Response		
<1>	IPSat Enable	0 = OFF, 1 = ON

Opcode: <245Ah> Query IPSat User Data Rate

Query Response

<4>	Data Rate	Bps. This represents the terrestrial data rate less the IPSat overhead.

Opcode: <245Bh> Query PCR Restamping

Query Response		
<1>	PCR Restamping	0 = Off, 1= On

Opcode: <245Ch> Query Multi-PIIC Configuration

Query Response		
<1>	Multi-PIIC Mode	1 = Manual, 2 = Redundancy
<1>	Redundancy Mode	0 = Force Prime, 1 = Force Backup, 2 = Manual Revert, 3 = Auto-Revert
<1>	Prime PIIC Slot	1 – 3
<1>	Backup PIIC Slot	1 – 3

Opcode: <245Dh> Query Multi-PIIC Status

Query Response		
<1>	Active PIIC Slot	1 – 3
<1>	Slot 1 PIIC Type	0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	Slot 2 PIIC Type	0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	Slot 3 PIIC Type	0x93 = ASI 0x94 = RS422 0x95 = LVDS Parallel 0x96 = ASI Out (Monitor) 0x9C = DirecTV PECL 0xFF = None
<1>	PIIC Clock Activity	Bit 1 = Slot 1 Activity Bit 2 = Slot 2 Activity Bit 3 = Slot 3 Activity
<1>	PIIC Data Activity	Bit 1 = Slot 1 Activity Bit 2 = Slot 2 Activity

		Bit 3 = Slot 3 Activity

Opcode: <2560h> Query RF Switch Status

Query Response		
<1>	Redundancy Mode	3 = Auto revert, 4 = Manual, 5 = Backup
<1>	Fault Test Switch	0 = Normal, 1 = Faulted
<1>	Connector	0 = Backup, 1 = Prime
<1>	Online Side	0 = Backup, 1 = Prime
<1>	Distant Status	0 = Normal, 1 = Faulted

Opcode: <2601h> Command a Modulator's Configuration

<4>	IF Frequency	Binary Value, units Hz in 100 Hz steps. 50000000 Hz to 180000000 Hz 70/140 950000000 Hz to 2050000000 Hz L-Band
<2>	Reserved	TBD
<4>	Data Rate	Binary Value, 1 bps Steps **(See note at the end of this command.)**
<4>	External Reference	Binary Value, units Hz in 8000 Hz steps, e.g. 1000000 Hz, 1008000 Hz, etc., Range = 256000 Hz to 10000000 Hz
<1>	Frequency	0 = Internal, 1 = External

	Reference Source	
<1>	Modulation Type	0 = QPSK, 1 = BPSK, 2 = 8PSK, 3 = 16QAM **(See note at the end of this command.)**
<1>	Inner FEC Rate	1 = 1/2 Rate, 2 = 2/3 Rate, 3 = 3/4 Rate, 4 = 5/6 Rate, 5 = 7/8 Rate, 6 = 6/7 Rate, 7 = 4/5 Rate, 8 = 8/9 Rate, 9 = 9/10 Rate, 128 = 1/4 Rate, 129 = 1/3 Rate, 130 = 2/5 Rate, 131 = 3/5 Rate **(See note at the end of this command.)**
<1>	Reserved	TBD, Default = 1
<1>	Reserved	TBD, Default = 1
<1>	Reserved	TBD, Default = 0
<1>	Reserved	TBD, Default = 0
<2>	Transmit Power Level	Signed Value. +0 to –250 (+0.0 to –25.0 dBm) (two's compliment)
<1>	Carrier Control	0 = Off, 1 = On
<1>	Carrier Test	0 = Off, 1 = CW, 2 = Dual, 3 = Offset, 4 = Pos FIR, 5 = Neg FIR
<1>	Spectrum	0 = Inverted, 1 = Normal
<1>	Reserved	TBD, 0 = Default
<1>	Tx Interface Type	0 = Serial, 1 = Parallel, 2 = ASI Norm, 3 = ASI Null, 4 = G.703 E3, 5 = G.703 T3, 6 = G.703 STS-1, 7 = HSSI, 8 = Parallel DVB, 9 = Parallel M2P, 10 = None, 11 = DirecTV, 13 = OC3, 14 = STM-1, 15 = G.703 E2, 16 = G.703 T2 Bal, 17 = G.703 T2 UNBAL, 18 = G.703 E1 Bal, 19 = G.703 E1 UNBAL, 20 = G.703 T1 AMI, 21 = G.703 T1 B8ZS **(See table at the end of this command.)**
<1>	Input Clock Polarity	0 = Normal, 1 = Inverted
<1>	Data Polarity	0 = Normal, 1 = Inverted
<1>	Input Clock Source	0 = SCTE, 1 = SCT
<1>	Reserved	TBD, Default = 0
<11>	Reserved	TBD
<1>	Reserved	TBD
<1>	Major Alarm Mask	Bit 0 = Spare Bit 1 = Transmit Oversample PLL Lock Bit 2 = FPGA Config Error Bit 3 = IF Synthesizer PLL Lock Bit 4 = External Reference PLL Lock Bit 5 = Composite (SCT) PLL Lock Bit 6 = Symbol PLL Lock

		Bit 7 = Spare 0 = Mask, 1 = Allow
<1>	Minor Alarm Mask	Bit 0 = Terrestrial Ethernet data activity detect Bit 1 = Loss Terrestrial Clock Bit 2 = Loss Terrestrial Data Bit 3 = FIFO Error Bit 4 = Output Level Bit 5 = Terrestrial Framing Error Bit 6 = Terr Ethernet jitter buffer underflow Bit 7 = Terr Ethernet jitter buffer overflow 0 = Mask, 1 = Allow
<1>	Common Fault Mask	Bit 0 = -12 V Alarm Bit 1 = +12 V Alarm Bit 2 = +5 V Alarm Bits 3 – 7 = Spares 0 = Mask, 1 = Allow
<1>	Reserved	TBD, Default = 0
<4>	Symbol Rate	Symbol Rate in Symbols Per Second **(See note at the end of this command.)**
<1>	Framing	0 = 188 Byte, 1 = 204 Byte, 2 = No Framing, 3 = DirecPC, 4 = DirecTV **(See note at the end of this command.)**
<1>	Roll Off	0 = 0.35, 25 = 0.25, 1 = 0.20
<1>	Reserved	TBD
<1>	Output Clock Source	0 = SCTE, 1 = SCT, 2 = None **(See table at the end of this command.)**
<1>	Network Spec	0 = DVB-S, 1 = Direct PC, 9 = DirecTV, 11 DVB-S2 BS NBC, 12 = DVB-S2 BS BC, 13 = DirecTV AMC NBC, 14 = DirecTV AMC BC
<1>	Scrambler Bypass	0 = Normal, 1 = Bypass
<1>	Outer FEC Bypass	0 = Normal, 1 = Bypass
<1>	Test Pattern	0 = None, 1 = 215 – 1, 23 = 223-1
<1>	Last Rate Control	0 = Symbol Rate, 1 = Data Rate, 2 = Auto (Must set to 1 = Data Rate if Tx Interface Type is set to any of the G.703 varieties)
<1>	Interleaver Bypass	0 = Bypass, 1 = Normal
<1>	PCR Restamping	0 = Off, 1= On
<1>	Multi-PIIC Mode	Without Multi-PIIC Card: 1 = Manual With Multi-PIIC Card: 1 = Manual, 2 = Redundancy

<1>	Redundancy Mode	Without Multi-PIIC Card or Manual Multi-PIIC Mode: 0 With Multi-PIIC Card: 0 = Force Prime, 1 = Force Backup, 2 = Manual Revert, 3 = Auto-Revert
<1>	Prime PIIC Slot	Without Multi-PIIC Card: 1 With Multi-PIIC Card: 1 – 3
<1>	Backup PIIC Slot	Without Multi-PIIC Card: 1 With Multi-PIIC Card: 1 – 3
<1>	Pilot Symbols	0 = Off, 1 = On
<1>	Inner FEC Bypass	0 = Normal, 1 = Bypass
<1>	PL Scrambler Bypass	0 = Normal, 1 = Bypass
<1>	PL Noise Generator Enable	0 = Disable, 1 = Enable
<1>	PL Noise Generator Profile	1 to 16
<2>	PL Header Scrambler Seq Index	1 to 2000
<4>	Gold Code Seq Index	0 to 262142

DM240 Clock Source Selection Matrix		
Interface Type	**InClk Source**	**OutClk Source**
RS-422 Serial	SCT or SCTE	SCT Only
DirecTV PECL	SCT or SCTE	SCT Only
G.703 (E3, T3, STS-1)	SCTE Only	SCT, SCTE, or None
HSSI	SCT or SCTE	SCT Only
OC3	SCTE Only	None
STM-1	SCTE Only	None
ASI	SCTE Only	None
M2P Parallel	SCT or SCTE	SCT Only

DVB Parallel	SCTE Only	SCT Only

Note When changing Data Rate, Symbol Rate, Inner FEC Rate, Modulation Type, or Framing Mode using the Mod All Command, the Data Rate and Symbol Rate parameter must be range checked using the following formulas to ensure they do not exceed the max limits:

Symbol Rate = (Data Rate * Overhead) / (Code Rate * Modulation)

Data Rate = (Symbol Rate * Code Rate * Modulation) / Overhead

Max Symbol rate	68 Msps.
Max Data Rate	238 Mbps with high-speed interface card.
Overhead	204/188 for 188 byte 204/204 for 204 byte 204/187 for none
Modulation	QPSK = 2 16QAM = 4 BPSK = 1 8PSK = 3
Code Rate	1/4, 1/3, 2/5, 3/5, 1/2, 2/3, 3/4, 5/6, 6/7, 7/8, 8/9, 9/10

Opcode: <2602h> Command a Modulator's Frequency

<4>	Frequency	Binary Value, units Hz in 100 Hz steps. 50000000 Hz to 180000000 Hz 70/140 950000000 Hz to 2050000000 Hz L-Band **(This command will cause the carrier to turn off).**

Opcode: <2604h> Command a Modulator's Data Rate

<4>	Data Rate	Binary Value, 1 BPS steps **(This command will cause the carrier to turn off).**

Opcode: <2606h> Command a Modulator's Modulation Type

<1>	Modulation Type	0 = QPSK, 1 = BPSK, 2 = 8PSK, 3 = 16QAM

Opcode: <2607h> Command a Modulator's Inner FEC Rate

<1>	Inner FEC Rate	1 = 1/2 Rate, 2 = 2/3 Rate, 3 = 3/4 Rate, 4 = 5/6 Rate, 5 = 7/8 Rate, 6 = 6/7 Rate, 7 = 4/5 Rate, 8 = 8/9 Rate, 9 = 9/10 Rate, 128 = 1/4 Rate, 129 = 1/3 Rate, 130 = 2/5 Rate, 131 = 3/5 Rate **(This command will cause the carrier to turn off.)**

Opcode: <2609h> Command a Modulator's Carrier Control

<1>	Carrier Control	0 = Off, 1 = On

Opcode: <260Ah> Command a Modulator's Carrier Test

<1>	Carrier Type	0 = Normal, 1 = CW, 2 = Dual, 3 = Offset, 4 = Pos FIR, 5 = Neg FIR

Opcode: <260Bh> Command a Modulator's Input Clock Control

<1>	Input Clock Control	0 = SCTE, 1 = SCT

Opcode: <260Ch> Command a Modulator's Input Clock Polarity

<1>	Input Clock Polarity	0 = Normal, 1 = Inverted

Opcode: <260Fh> Command a Modulator's Output Level

<2>	Transmit Power Level	Signed Value. +0 to –250 (+0.0 to –25.0 dBm) (two's compliment)

Opcode: <2611h> Command a Modulator's Spectrum

<1>	Spectrum	0 = Inverted, 1 = Normal

Opcode: <2616h> Command a Modulator's External Reference Source

<1>	External Reference Source	0 = Internal, 1 = External

Opcode: <2619h> Command DM240 Network Spec

<1>	Network Spec	0 = DVB-S, 1 = Direct PC, 9 = DirecTV, 11 DVB-S2 BS NBC, 12 = DVB-S2 BS BC, 13 = DirecTV AMC NBC, 14 = DirecTV AMC BC

Opcode: <261Bh> Command a Modulator's External Reference Frequency

<4>	External Reference Frequency	Binary Value, units Hz in 8000 Hz steps, e.g. 1000000 Hz, 1008000 Hz, etc., Range = 256000 Hz to 10000000 Hz

Opcode: <2620h> Command a Modulator's Data Polarity

<1>	Data Polarity	0 = Normal, 1 = Inverted

Opcode: <2621h> Command a Modulator's Interface Type

<1>	Tx Interface Type	0 = Serial, 1 = Parallel, 2 = ASI Norm, 3 = ASI_Null, 4 = G.703E3, 5 = G.703 T3, 6 = G.703 STS-1, 7 = HSSI, 8 = Parallel DVB, 9 = Parallel M2P, 10 = None, 11 = DirecTV, 13 = OC3, 14 = STM-1, 15 = G.703 E2, 16 = G.703 T2 Bal, 17 = G.703 T2 UNBAL, 18 = G.703 E1 Bal, 19 = G.703 E1 UNBAL, 20 = G.703 T1 AMI, 21 = G.703 T1 B8ZS

Opcode: <2640h> Command a Modulator's Terrestrial Framing

<1>	Terrestrial Framing	0 = 188 Byte, 1 = 204 Byte, 2 = No Framing, 3 = DirecPC, 4 = DirecTV

Opcode: <2641h> Command a Modulator's Roll Off

<1>	Roll Off	0 = 0.35, 25 = 0.25, 1 = 0.20

Opcode: <2642h> Command a Modulator's Output Clock Source

<1>	Output Clock Source	0 = SCTE, 1 = SCT, 2 = None

Opcode: <2643h> Command a Modulator’s Symbol Rate

<1>	Symbol Rate	Binary Value, 1 bps Steps **(This command will cause the carrier to turn off.)**

Opcode: <2656h> Command AASI NULL PID

<2>	PID	0x0010 - 0x1FFF

Opcode: <2657h> Command IPSat Burst Demod Count

<2>	Num Burst Demods	1 – 50

Opcode: <2658h> Command IPSat Control PID

<2>	PID	0x0010 - 0x1FFF

Opcode: <2659h> Command IPSat Enable

<1>	IPSat Enable	0 = OFF, 1 = ON

Opcode: <265Bh> Command PCR Restamping

<1>	PCR Restamping	0 = Off, 1= On

Opcode: <265Ch> Command Multi-PIIC Configuration

<1>	Multi-PIIC Mode	1 = Manual, 2 = Redundancy
<1>	Redundancy Mode	0 = Force Prime, 1 = Force Backup, 2 = Manual Revert, 3 = Auto-Revert
<1>	Prime PIIC Slot	1 – 3
<1>	Backup PIIC Slot	1 – 3

Opcode: <2C03h> Command Clear Latched Alarms

		No Parameters

Opcode: <2C04h> Command Set Time

<1>	Hour	0 – 23
<1>	Minute	0 – 59
<1>	Second	0 – 59

Opcode: <2C05h> Command Set Date

<1>	Year	00 – 99
<1>	Month	1 – 12
<1>	Day	1 – 31

Opcode: <2C06h> Command Set Time and Date

<1>	Year	00 – 99
<1>	Month	1 – 12
<1>	Day	1 – 31
<1>	Hour	0 – 23
<1>	Minute	0 – 59
<1>	Second	0 – 59

Opcode: <2F40h> Command RF Redundancy Mode

<1>	Redundancy Mode	3 = Auto revert, 4 = Manual, 5 = Backup

Opcode: <2F41h> Command RF Fault Test

<1>	Fault Test	0 = Normal, 1 = Faulted

Opcode: <2F42h> Command RF Active Side

<1>	Active Side	0 = Backup, 1 = Prime